(12) UK Patent Application (19) GB (11) 2 253 081 (13) A

(43) Date of A publication 26.08.1992

(21) Application No 9203663.1

(22) Date of filing 19.02.1992

(30) Priority data
(31) 03026379 (32) 20.02.1991 (33) JP

(71) Applicant
Kabushiki Kaisha Toshiba

(Incorporated in Japan)

72 Horikawa-cho, Saiwai-ku, Kawasaki-shi, Kanagawa-ken, Japan

(72) Inventors
Hisaaki Hatano
Toru Yamagishi

(74) Agent and/or Address for Service
Marks & Clerk
57-60 Lincoln's Inn Fields, London, WC2A 3LS, United Kingdom

(51) INT CL[5]
G06F 15/21

(52) UK CL (Edition K)
G4A AUB

(56) Documents cited
GB 2224868 A
"Harnessing neural networks", Electronics World and Wireless World, Dec 1990, pp 1047-1052

(58) Field of search
UK CL (Edition K) G4A AUB AUX, G4G GAL GAX
INT CL[5] G06F 15/21 15/36, G06G 7/52
On-line database: WPI.

(54) Security-exchange decision-making support

(57) A security-exchange decision-making support apparatus includes an input unit 10, a neural network 20, and an evaluation unit 40. The input unit samples stock market prices over time, 12, and obtains, 14, maxima of upwardly moving prices and minima of downwardly moving prices. The neural network has a unit 30 for outputting a signal representing at least one of "buy" and "sell" and a plurality of input units for receiving the maxima and minima values. Weighting values of nodes of the network are changed by repetitive adjustment, 44, based on an evaluation, 42, of the output from the output unit.

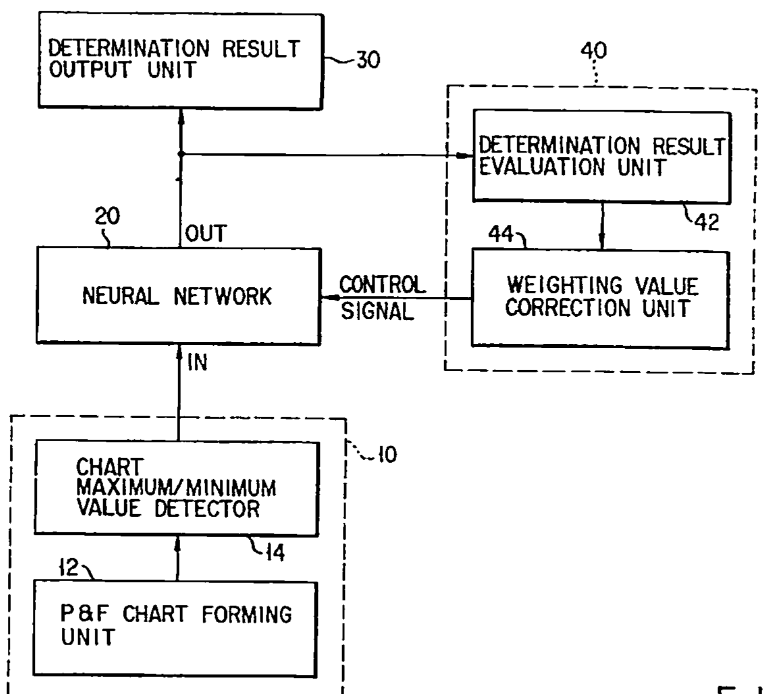
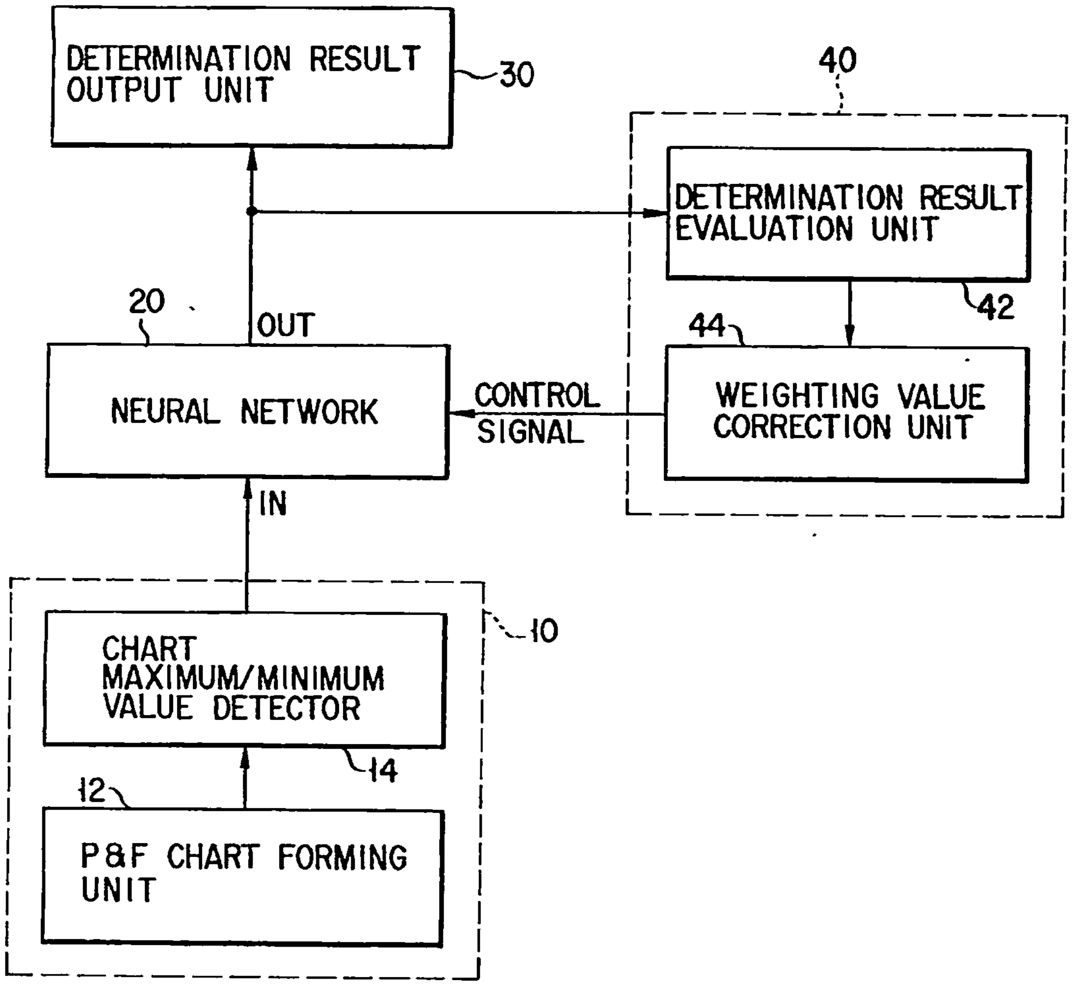
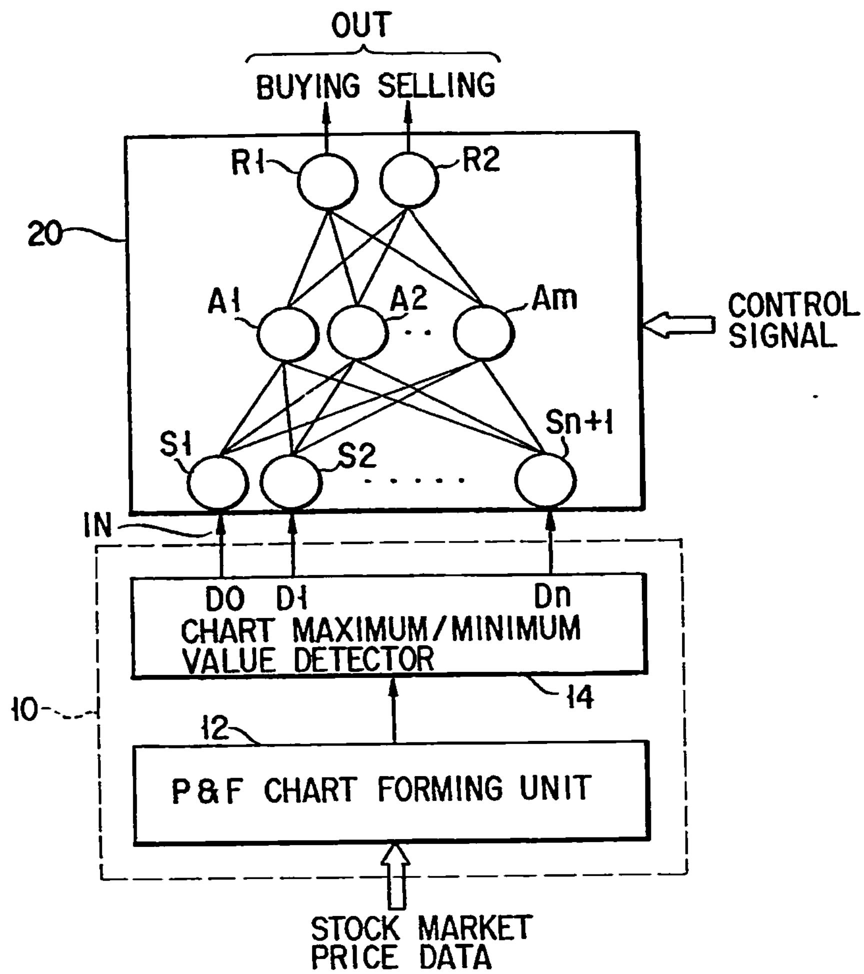


FIG. 1

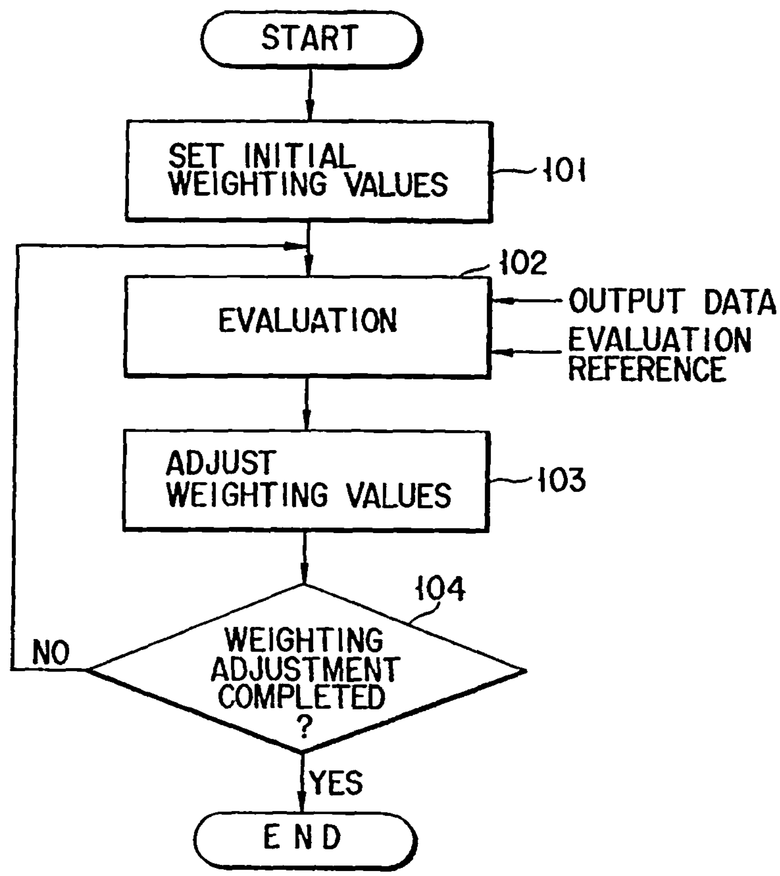
GB 2 253 081 A


DETERMINATION RESULT OUTPUT UNIT
30
40
DETERMINATION RESULT EVALUATION UNIT
42
20
OUT
44
NEURAL NETWORK
CONTROL SIGNAL
WEIGHTING VALUE CORRECTION UNIT
IN
10
CHART MAXIMUM/MINIMUM VALUE DETECTOR
14
12
P&F CHART FORMING UNIT

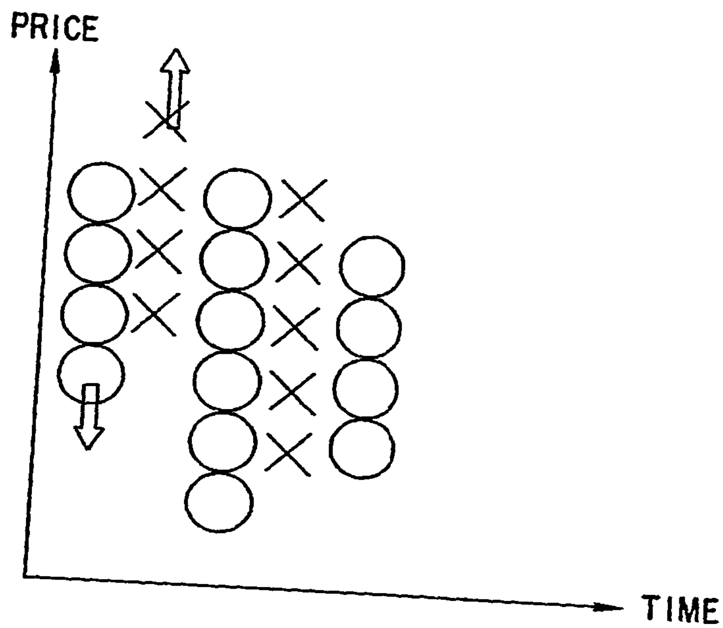
F I G. 1


OUT
BUYING SELLING
R1
R2
20
A1
A2
Am
CONTROL SIGNAL
S1
S2
Sn+1
IN
D0 D1
Dn
CHART MAXIMUM/MINIMUM VALUE DETECTOR
14
10
12
P&F CHART FORMING UNIT
STOCK MARKET PRICE DATA

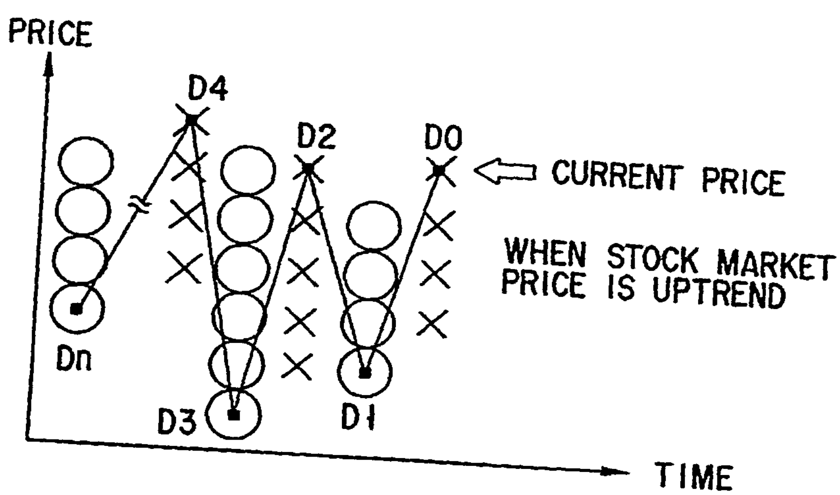
F I G. 2


START
SET INITIAL WEIGHTING VALUES
101
102
EVALUATION
OUTPUT DATA
EVALUATION REFERENCE
ADJUST WEIGHTING VALUES
103
104
WEIGHTING ADJUSTMENT COMPLETED ?
NO
YES
END

F I G. 3


PRICE
TIME

F I G. 4


PRICE
D4
D2
D0
CURRENT PRICE
WHEN STOCK MARKET
PRICE IS UPTREND
Dn
D3
D1
TIME

F I G. 5

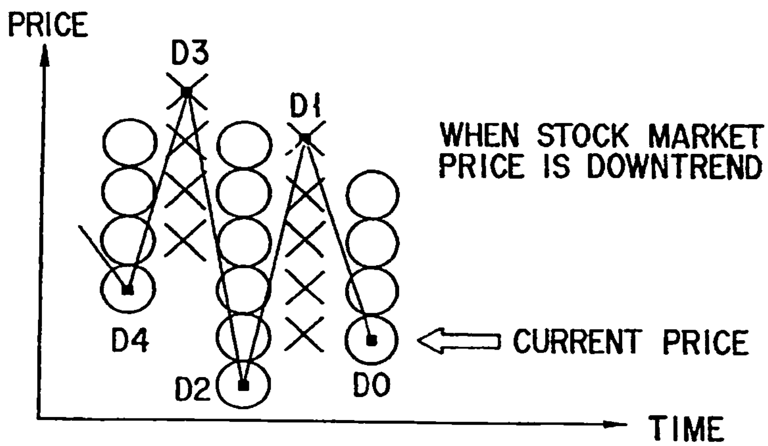

PRICE
D3
D1
WHEN STOCK MARKET PRICE IS DOWNTREND
D4
D2
D0
CURRENT PRICE
TIME

FIG. 6

"SECURITY EXCHANGE DECISION-MAKING SUPPORT APPARATUS AND METHOD OF SUPPORTING SECURITY EXCHANGE DECISION MAKING, USING THE SAME"

The present invention relates to a security exchange decision-making support apparatus for supporting decision making in security exchange from time-series data representing prices on a stock market and, more particularly, a security exchange decision-making support apparatus constituted by using a neural network and a method of supporting decision making in security exchange using this apparatus.

Various conventional methods for converting raw data representing price changes over time on a stock market into a chart, and making a decision in security exchange in accordance with whether typical patterns for motivating an exchange timing are present in the chart are known.

Various systems which adopt computers for decision making in security exchange so as to perform decision making in security exchange are also known.

Most of the typical patterns for motivating exchange timings, which appear on the chart, rely on dealers' (or stock analysts') intuition. It is, therefore, very difficult to shematically generalize the patterns. Low ability of generalization makes it difficult to change typical patterns for motivating exchange timings dynamically according to result applying them to the price data.

It is an object of the present invention to provide

a security exchange decision-making support apparatus capable of supporting security exchange decision making with a considerably high probability by introducing a neural network suitable for processing of ill-structured data and capable of improving a hit probability in a variety of applications, and a method of supporting the security exchange decision making by using this apparatus.

A security exchange decision-making support apparatus according to the present invention is characterized by comprising:

input unit for sampling time-series data of floating stock market prices as up and down prices until a current stock market price, obtaining a maximum value of the plurality of up prices and a minimum value of the plurality of down prices, and outputting the maximum and minimum values;

a neural network having an output element for outputting a signal representing at least one of buying and selling as a determination result, a plurality of input elements for receiving an output from the input unit, and a plurality of nodes connected between the output element and the input elements and having weighting values, the weighting values being changed by learning using repetitive weighting adjustment based on an evaluation of the output from the output element; and

evaluating unit for receiving the determination

result output from the neural network, evaluating the determination result represented by the input signal, and outputting a signal for correcting the weighting values of the nodes in the neural network when the evaluating unit evaluates that the determination result represents necessity for correction of the weighting values.

In addition, a method of supporting security exchange decision making using a security exchange decision-making support apparatus including a neural network which has a plurality of input elements and at least one output element, is characterized by comprising the steps of:

the first step of setting weighting values of nodes between the elements in the neural network to predetermined values;

the second step of receiving stock market price data, sampling stock market prices as up and down prices until a current price in accordance with an increase and a decrease by a predetermined amount, and forming a P & F chart on the basis of the sampled up and down prices;

the third step of obtaining a maximum value of the plurality of sampled up prices and a minimum value of the plurality of sampled down prices to detect the maximum and minimum values;

the fourth step of outputting a determination

result for buying and selling of securities in accordance with the detected maximum and minimum values and the weighting values of the nodes between the elements in the neural network;

the fifth step of evaluating validity of the determination result;

the sixth step of correcting the weighting values of the neural network if the determination result is judged to require correction of the weighting values in the fifth step; and

the seventh step of repeating one of the following steps and until weighting adjustment of the neural network is completed,

the step being the step of repeating the fourth to sixth steps when revolution is performed using the same data, and

the step being the step of repeating the second to sixth steps when evaluation is performed on the basis of new stock market price data.

A system associated with security exchange decision-making support samples stock market prices as up prices for every increase in predetermined amount as long as the stock market prices are in the uptrend. This system samples stock market prices as down prices for every decrease in predetermined amount when the stock market prices are in the downtrend. In this system, a maximum value of the plurality of up prices

and a minimum value of the down prices, all of which are obtained by repeating the above sampling operations until the current stock market prices, are input to a plurality of elements of the neural network. Finally, an output element of the neural network makes a decision in security exchange. In this case, weighting values between the elements in the neural network are changed in accordance with repetitive weighting adjustment learning based on evaluation values from the output element. Therefore, when the frequency of use of this apparatus is increased, a hit probability of decisions in security exchange output from the output element in the neural network is increased.

In the security exchange decision-making support system according to the present invention, when the neural network suitable for processing ill-structured data is introduced in security exchange decision making, a decision in security exchange is made in accordance with the output from the neural network. Therefore, the security exchange decision making can be supported with a relatively high hit probability by the security exchange decision-making support system of the present invention. In addition, the probability of a hit can be increased depending on market conditions.

In addition, by using a method of supporting security exchange decision making by using the security exchange decision-making apparatus according to the

present invention, the security exchange decision making can be supported with a high hit probability and the hit probability can be increased.

This invention can be more fully understood from the following detailed description when taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a block diagram showing a security exchange decision-making support apparatus according to an embodiment of the present invention;

Fig. 2 is a diagram showing a detailed arrangement of a data input unit 10 and a neural network 20 in Fig. 1;

Fig. 3 is a flow chart for explaining an operation of the embodiment shown in Fig. 1;

Fig. 4 is a graph showing a P & F chart used in the embodiment shown in Fig. 1;

Fig. 5 is a graph showing a P & F chart obtained when stock market prices are in the uptrend; and

Fig. 6 is a graph showing a P & F chart obtained when stock market prices are in the downtrend.

A preferred embodiment of the present invention will be described in detail with reference to the accompanying drawings.

Fig. 1 is a block diagram showing a security exchange decision-making support apparatus according to an embodiment of the present invention. This apparatus comprises a data input unit 10, a neural network 20,

a determination result output unit 30, and an evaluation unit 40. The data input unit 10 is connected to the neural network 20. The neural network 20 is connected to the determination result output unit 30, and the evaluation unit 40. The data input unit 10 is a unit for receiving stock market price data. That is, the data input unit 10 receives external data serving as the basis of security exchange decision making. The neural network 20 receives data from the data input unit 10 and determines security exchange decision making. The determination result output unit 30 displays or prints out a selling or buying certainty output from the neural network 20. The evaluation unit 40 determines whether the selling or buying probability output from the neural network 20 is correct. The evaluation unit 40 changes such as weighting values and threshold values in the neural network 20 (to be described in detail later).

The data input unit 10 comprises a P & F chart forming unit 12 for forming a P & F chart from the stock market price data (to be described in detail later), and a chart maximum/minimum value detector 14 for detecting maximum and minimum values in the P & F chart. The evaluation unit 40 comprises a determination result evaluation unit 42 for evaluating whether the selling or buying determination result output from the neural network 20 is correct, and a weighting value correction unit 44 for outputting a signal for changing a weighting

value in a node between the elements in the neural network 20. The determination made in the determination result evaluation unit 42 may be performed with reference to a given input determination reference or by a stock analyst. The weighting value correction unit 44 may output a signal for changing a threshold value of each element in the neural network 20.

The detailed arrangement of the data input unit 10 and the neural network 20 shown in Fig. 1 is shown in Fig. 2. The neural network 20 comprises, e.g., a so-called layered network. Referring to Fig. 2, the neural network 20 is constituted by three-layered elements for executing processing operations while these operations influence each other.

The neural network 20 shown in Fig. 2 will be described in detail below.

The first layer is called an S unit (sensor unit) group. The S unit group comprises (n+1) units (elements) S1, S2, ..., Sn+1. The S units receive (n+1) data D0, D1, ..., Dn as the basis of the security exchange decision making. The (n+1) data D1, D1, ..., Dn will be described in detail later.

The second layer is called an A unit (associative unit) group. The A unit group comprises m units (elements) A1, A2, ..., Am. The A units A1, A2, ..., Am and the (n+1) units S1, S2, ..., Sn+1 of the S unit group are connected by a plurality of weighted nodes.

The third layer is called an R unit (response unit) group. The R unit group comprises a first unit (element) R1 and a second unit (element) R2. The first unit R1 outputs a buying signal. The second unit R2 outputs a selling signal. The first and second units R1 and R2 are connected to the m units A1, A2, ..., Am of the A unit group through a plurality of weighted nodes.

The weighting values of the plurality of nodes between the (n+1) units S1, S2, ..., Sn+1 of the first layer and the m units A1, A2, ..., Am of the second layer and the weighting values of the m nodes of the second layer are adjusted and changed by learning in accordance with evaluation values represented by the buying and selling signals output from the first and second units R1 and R2, i.e., the hit probabilities (hit/miss probability) in security exchange. The buying and selling signals need not be buying and selling signals, but may be represented by numeric values of buying determination certainty. Each unit can have a threshold value to determine whether a signal is output in response to the intensity of an input signal.

Fig. 3 is a flow chart showing processing for adjusting weighting values of the nodes between the elements in the neural network 20.

The weighting values of the nodes between the elements in the neural network 20 are initialized on the basis of an appropriate empirical rule (step 101). This

initial setup may be performed using random numbers or by a stock analyst. Data input to the neural network 20 in the state of step 101 are evaluated so that the buying and selling signals output from the first and second units R1 and R2 are evaluated (step 102). This evaluation operation is performed by the determination result evaluation unit 42 in the evaluation unit 40 on the basis of the data output from the first and second units R1 and R2 and a predetermined evaluation reference. The weighting values of the nodes between the elements are adjusted by the weighting value correction unit 44 in the evaluation unit 40 in correspondence with the above evaluation operation (step 103). In this step, not only the weighting values of the nodes between the elements but also threshold values of the elements can be adjusted. The buying and selling signals output from the first and second units R1 and R2 are evaluated again (step 102). The weighting values of the nodes between the elements are adjusted in correspondence with the above evaluation (step 103). The operations in steps 102 and 103 are repeated until it is determined by the evaluation unit 40 that the weighting value adjustment is completed (step 104).

The evaluation of the buying and selling signals output from the first and second units R1 and R2 can be improved. That is, the hit probability in security exchange can be gradually increased. Therefore,

decision making in security exchange can be performed with a high hit probability.

In this embodiment, a plurality of extreme values (maximum and minimum values) of the so-called P & F chart (point-and-figure chart) are used as (n+1) data which serve as the basis of security exchange decision making and which are input from the data input unit 10 to the (n+1) units S1, S2, ..., Sn+1 of the first layer in the neutral network 20 shown in Fig. 2.

The P & F chart will be briefly described below. The P & F chart is a graph in which marks o and × are plotted on a two-dimensional graph to represent changes in stock market prices. In this graph, the stock market prices are plotted along the ordinate, and time is plotted along the abscissa.

A P & F chart is shown in Fig. 4. Referring to Fig. 4, when a stock market price is in the downtrend, marks o are sequentially plotted downward in a column for every decrease in predetermined amount. When the stock market price turns to the uptrend, the current column is shifted to the right by one, and marks × are sequentially plotted upward in a column. When this stock market price turns to the downtrend again, the current column is shifted again to the right by one, and marks o are sequentially plotted downward in a column. This series of operations is repeated until the price reaches a current stock market price.

As is apparent from the above description, time plotted along the abscissa does not represent a linear relationship. The time between the columns formed by the marks o and × varies depending on a pattern of changes in stock market prices. Note that the marks o and × represent predetermined unit prices.

In this embodiment, the plurality of extreme values of the P & F chart shown in Fig. 4, i.e., stock market prices are input to the (n+1) units S1, S2, ..., Sn+1 of the first layer in the neural network 20 after these data are processed by the data input unit 10 shown in Fig. 1.

Processing of the input unit 10 for the P & F chart will be described below. The P & F chart forming unit 12 receives external stock market price data (regardless of an on/off-line state) and forms a P & F chart on the basis of the input data. The chart maximum/minimum value detector 14 detects a maximum value during an uptrend in stock market price and a minimum value during a downtrend in stock market price as a function of time on the P & F chart. The maximum and minimum values are output to the (n+1) units S1, S2, ..., Sn+1 of the first layer in the neural network 20.

A plurality of extreme values of the P & F chart input to the (n+1) units S1, S2, ..., Sn+1 of the first layer in the neural network 20 through the data input unit 10 shown in Fig. 1 or 2 will be described with

reference to Figs. 5 and 6 in detail below. Figs. 5 and 6 show P & F charts showing states in which stock market prices are currently in an uptrend and downtrend, respectively.

Fig. 5 shows the P & F chart showing a state wherein a stock market price is currently in an uptrend. Referring to Fig. 5, a current security price is represented by D0. An extreme value in a downtrend before the current price D0 is represented by D1, an extreme value in an uptrend before the extreme value D1 is represented by D2, an extreme value in a downtrend before the extreme value D2 is represented by D3, and an extreme value in an uptrend before the extreme value D3 is represented by D4. In this case, D0, D1, ..., Dn are respectively input to the (n+1) units S1, S2, ..., Sn+1 of the first layer in the neural network 20 through the data input unit 10 shown in Fig. 1.

Fig. 6 shows the P & F chart showing a state wherein a stock market price is currently in a downtrend. Referring to Fig. 6, a current security price is represented by D0. An extreme value in an uptrend before the current price D0 is represented by D1, an extreme value in a downtrend before the extreme value D1 is represented by D2, an extreme value in an uptrend before the extreme value D2 is represented by D3, and an extreme value in a downtrend before the extreme value D3 is represented by D4. In this case,

data D0, D1, ..., Dn corresponding to the prices or extreme values D0, D1, ..., Dn are respectively input to the (n+1) units S1, S2, ..., Sn+1 of the first layer in the neural network 20 through the data input unit 10 shown in Fig. 1.

When the above data are input to the (n+1) units S1, S2, ..., Sn+1 of the first layer in the neural network 20 through the data input unit 10 shown in Fig. 1, the (n+1) units S1, S2, ..., Sn+1 of the first layer respond to these input data. The m units A1, A2, ..., Am of the second layer receive signals from the (n+1) units S1, S2, ..., Sn+1 of the first layer through the corresponding nodes and respond to the input data. The first and second units R1 and R2 of the third layer receive the signals from the n units A1, A2, ..., Am and output buying and selling signals, respectively. The buying and selling signals output from the first and second units R1 and R2 of the third layer are determined by the data D1, D2, ..., Dn input to the (n+1) units S1, S2, ..., Sn+1 of the first layer, the weighting values of the plurality of nodes between the (n+1) units S1, S2, ..., Sn+1 of the first layer and the m units A1, A2, ..., Am of the second layer, and the weighting values of the plurality of nodes between the m units A1, A2, ..., Am of the second layer and the first and second units R1 and R2 of the third layer. As previously described, the weighting values of the nodes between the

units in the neural network 20 are adjusted and changed by learning in accordance with the evaluation values represented by the buying and selling signals output from the first and second units R1 and R2, i.e., the hit probabilities for security exchange decision making. Therefore, the evaluation values represented by the buying and selling signals output from the first and second units R1 and R2 are increased. That is, the hit probabilities for security exchange decision making can be increased; security exchange decision making can be performed with high hit probabilities.

In the above embodiment, the buying and selling signals are output from the two output units R1 and R2. However, only one output element may be used to determine buying and selling in accordance with the magnitude of an output from the output element.

The neural network 20 has a feed forward network structure. However, a recurrent network structure may be used in place of the layered network structure.

The present invention is not limited to the particular embodiment described above. Various changes and modifications may be made without departing from the spirit and scope of the invention.

Claims:

1. A security exchange decision-making support apparatus comprising:

input means for sampling time-serial data of floating stock market prices as up and down prices until a current stock market price, obtaining a maximum value of the plurality of up prices and a minimum value of the plurality of down prices, and outputting the maximum and minimum values;

a neural network having an output unit for outputting a signal representing at least one of buying and selling as a determination result, a plurality of input units for receiving an output from said input unit, and a plurality of nodes connected between said output unit and said input units and having weighting values, the weighting values being changed by learning using repetitive weighting adjustment based on an evaluation of the output from said output unit; and

evaluating means for receiving the determination result output from said neural network, evaluating the determination result represented by the input signal, and outputting a signal for correcting the weighting values of said nodes in said neural network when said evaluating means evaluates that the determination result represents necessity for correction of the weighting values.

2. An apparatus according to claim 1, further

comprising determination result output means for outputting the determination result output from said neural network.

3. An apparatus according to claim 1, wherein said input means includes:

P & F chart forming means for forming a P & F chart on the basis of the data obtained from the stock market prices; and

chart maximum/minimum value detecting means for detecting the maximum and minimum values of the P & F chart on the basis of the P & F chart formed by said P & F forming means.

4. An apparatus according to claim 1, wherein said neural network comprises a layered network.

5. An apparatus according to claim 1, wherein said evaluating means includes:

a determination result evaluating unit for evaluating validity of the determination result output from said neural network; and

weighting value correcting means for outputting a signal for correcting the weighting values to said neural network in accordance with an evaluation result from said determination result evaluating unit when said determination result evaluating unit determines that the determination result represents necessity for correction of the weighting values.

6. An apparatus according to claim 5, wherein said

determination result evaluating means includes means for changing threshold values set in said units in said neural network.

7. A security exchange decision-making support apparatus comprising:

P & F chart forming means for sampling time-serial data of floating stock market prices as up and down prices until a current stock market price to form a P & F chart;

chart maximum/minimum value detecting means for obtaining a maximum value of the plurality of sampled up prices and a minimum value of the plurality of sampled down prices and detecting the maximum and minimum values;

a neural network having an output unit for outputting a signal representing at least one of buying and selling as a determination result, a plurality of input units for receiving an output from said input unit, and a plurality of nodes connected between said output unit and said input units and having weighting values, the weighting values being changed by learning using repetitive weighting adjustment based on an evaluation of the output from said output unit;

a determination result evaluation unit for evaluating validity of the determination result output from said neural network; and

weighting value correcting means for outputting

a signal for correcting the weighting values to said neural network in accordance with an evaluation result from said determination result evaluating unit when said determination result evaluating unit determines that the determination result represents necessity for correction of the weighting values.

8. An apparatus according to claim 7, further comprising determination result output means for outputting the determination result output from said neural network.

9. A method of supporting security exchange decision making using a security exchange decision-making support apparatus including a neural network, said neural network having a plurality of input units and at least one output unit, comprising:

the first step of setting weighting values of nodes between said units in said neural network to predetermined values;

the second step of receiving stock market price data, sampling stock market prices as up and down prices until a current price in accordance with an increase and a decrease by a predetermined amount, and forming a P & F chart on the basis of the sampled up and down prices;

the third step of obtaining a maximum value of the plurality of sampled up prices and a minimum value of the plurality of sampled down prices to detect the

maximum and minimum values;

the fourth step of outputting a determination result for buying and selling of securities in accordance with the detected maximum and minimum values and the weighting values of said nodes between said units in said neural network;

the fifth step of evaluating validity of the determination result;

the sixth step of correcting the weighting values of said neural network if the determination result is evaluated to require correction of the weighting values in the fifth step; and

the seventh step of repeating one of the following steps and until weighting adjustment of said neural network is completed,

the step being the step of repeating the fourth to sixth steps when revolution is performed using the same data, and

the step being the step of repeating the second to sixth steps when evaluation is performed on the basis of new stock market price data.

10. A method according to claim 9, wherein the fourth step includes the step of changing threshold values set in said units in said neural network.

11. A security exchange decision-making support apparatus, substantially as hereinbefore described with reference to Figs. 1 to 2.

12. A method of supporting security exchange decision making, using a security exchange decision making support apparatus, substantially as hereinbefore described with reference to Figs. 1 to 3.

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

Application number
9203663.1

Relevant Technical fields

(i) UK Cl (Edition K) G4A (AUB,AUX); G4G (GAL,GAX)

(ii) Int CL (Edition 5) G06F (15/21,15/36); G06G (7/52)

Search Examiner
B G WESTERN

Databases (see over)

(i) UK Patent Office

(ii) ONLINE DATABASE: WPI

Date of Search
7 MAY 1992

Documents considered relevant following a search in respect of claims 1-12

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
X	GB 2224868 A (HITACHI) - See whole document	1,2,4,5
A	"Harnessing neural networks", Electronics World and Wireless World, December 1990, pages 1047-1052	1-12

SF2(p) wl - c:\wp51\doc99\fil002366

Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family, corresponding document.

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).

Published 1992 at The Patent Office. Concept House. Cardiff Road. Newport. Gwent NP9 1RH. Further copies may be obtained from Sales Branch. Unit 6. Nine Mile Point. Cwmfelinfach. Cross Keys. Newport. NP1 7HZ. Printed by Multiplex techniques ltd. St Mary Cray. Kent.